ADVAIT MEHLA

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Education

Indian Institute of Technology Bombay *(Nov '20 - present)*

- Major degree (with Honors) : Bachelors of Technology in Engineering Physics - **CPI** : **8.91/10**
- Minor degree : Department of Electrical Engineering

Scholastic Achievements

- Awarded a **Branch Change** to **Engineering Physics** based on exemplary academic performance *('21)*
- Secured a percentile of **99.923** among over **1 million** candidates in **JEE Mains** *('20)*
- Awarded the **KVPY fellowship** by DST, Govt. of India **twice** with **All India Ranks 306** and **466** *('19,'18)*
- Among the **top 450** students nationally selected for **Indian National Physics Olympiad(INPhO)** *('19)*

Publications

- Bhalerao V., Sawant D., . . . , Mehla A. et al. Science with the Daksha High Energy Transients Mission (ArXiv:2211.12052). Submitted to *The Astrophysical Journal* *(2022)*
- Bala S., . . . , Mehla A. et al. Polarisation capabilities of the Daksha Mission. *Manuscript in preparation*

Key Projects

Characterising the Spectral & Polarimetric Response of CZT Detectors *(Nov '21 - present)*

Prof. Varun Bhalerao, Dept. of Physics IIT Bombay; Dr. Sujay Mate, Tata Institute of Fundamental Research
Daksha is a proposed space telescope mission consisting of a pair of satellites to act as a high energy all-sky monitor. Cadmium Zinc Telluride detectors shall be used to analyse GRBs in the 20-200 keV energy range.

- Simulated the interactions of photons with detectors using the **Geant4 toolkit** developed by **CERN**
- Created a **pipeline** to construct **response files** for inferring **source spectra** from the detected counts
- Involved in the development of a processing pipeline to implement **Compton Polarimetry** with **pixellated detectors** in order to **determine polarisation** of sources and estimate the Minimum Detectable Polarisation
- Work on the polarisation capabilities of Daksha was presented at the *Astrophysical Polarimetry in the Time-Domain Era* conference held at Politecnico di Milano - Lecco, Italy as a poster with me among the co-authors

Team Member, GLEE | IIT Bombay Student Satellite Program *(May '21 - June '22)*

A 70+ member student team with the vision of making IIT Bombay a centre of excellence in space technology

- **Instrumentation Subsystem**
  - Scrutinised components & constructed a multi-stage **readout circuit** for a PIN diode based **spectroscope**
  - Tested and verified the functioning of the circuit by simulating input signals & analysing the output waveform
- **Communications Subsystem**
  - Designed several iterations of a 4cm x 4cm **prototype ChipSat** capable of processing and **wirelessly transmitting** data from the **lunar environment** gathered by **two sensors** interfaced with a microcontroller
  - Learnt **embedded C** and implemented **UART**, **SPI** communication protocols to achieve data transmission

Truly Random Number Generator using Chaos | *Course Project* *(Autumn '22)*

PH435: Microprocessors Lab, Prof. Pradeep Sarin, Department of Physics

- Designed, simulated and constructed a chaotic Chua circuit tuned to operate in the double scroll region
- Interfaced the circuit with an Arduino and pre-processed the bitstream using the von Neumann whitening algorithm to de-skew the incoming random bits
- Generated millions of random bits and subjected them to rigorous verification of randomness from the NIST test suite including the frequency, runs, π estimation and entropy tests

Resonant Mass GW Detectors : Instrumentation & Noise Sources | *Course Project* *(Autumn '22)*

PH821: Gravitational Wave Astronomy and Physics, Prof. Archana Pai, Department of Physics

- Surveyed literature on resonant bar based gravitational wave detectors and the measurement challenges associated
- Analysed the electro-mechanical oscillator system and its transfer function to understand its advantages
- Quantified the minimal detectable energy and noise spectral density of the dominant noise sources in the system

Closed Loop LED Controller | *Course Project* *(Autumn '21)*

PH 233: Op-amp Circuits Lab, Prof. Pradeep Sarin, Department of Physics

- Designed a **P−Type Controller** that regulates the intensity of an LED in accordance to external noise
- **Debugged** and **tuned** the circuit parameters after implementing it on a breadboard using operational amplifiers

Simulating Kirkwood Gaps *(July '21 - Sept '21)*

Krittika, the Astronomy Club of IIT-B (Summer Project)

- Implemented a **Monte Carlo simulation** to evolve large distributions of asteroids over millions of years
- Observed the emergence of **Kirkwood gaps** in the **asteroid belt** along with features like the Jupiter Trojans
- Optimised simulation times by a factor of **6 to 12** via implementation of **parallelised code** and utilisation of **high performance computing** libraries like **OpenMP** and **CUDA Fortran**

Analysis of the Nonlinear Dynamics of Neuronal Models | *Course Project* *(Autumn '21)*

PH567: Nonlinear Dynamics and Chaos, Prof. Amitabha Nandi, Department of Physics

- Designed and constructed an **analog circuit** to mimic the Nagumo **neuronal model** and demonstrated the **action potential** and other **neuronal behaviour** by visualising signals on a digital oscilloscope
- Explored the **phase space** of the **Fitzhugh model** by numerically integrating the dynamical equations

Positions of Responsibility

Manager | *Krittika, the Astronomy Club of IIT Bombay* *(June '22 - present)*

- Leading a team of **7 conveners** to organise & conduct events to propagate astronomy at IITB and beyond
- Spearheading the development of the **IIT Bombay Observatory** with an initial funding of INR 180K
- Organized the **Krittika Summer Projects**, an **8-week** long program aimed at exposing students to astronomical research & received **100+ applications** along with **international participation** for the first time
- Hosted observing sessions where **500+** students viewed various astronomical objects through telescopes

Convener | *Krittika, the Astronomy Club of IIT Bombay* *(June '21 - April '22)*

- Conducted a **session on astrophotography** and a hands-on **image processing** demonstration using Hubble raw data attended by **30+** astronomy enthusiasts, as part of a larger **Lecture Series** on astronomy
- Designed a Python-based **problem statement** on **Hertzsprung - Russell** Diagrams for the **Krittika Summer Projects** conducted for first year students and guided participants through solving it

Key Courses

Physics	General Theory of Relativity, Gravitational Wave Physics & Astronomy*, Quantum Mechanics I, Quantum Mechanics II*, Photonics*, Classical Mechanics, Nonlinear Dynamics
Mathematics	Differential Calculus, Integral Calculus, Linear Algebra, Complex Analysis, Differential Equations I, Differential Equations II, Numerical Analysis
Electronics	Basic Circuits Lab, Op Amp Circuits Lab, Digital Electronics Lab, Microprocessors Lab*, Digital Systems, Electronic Devices, Signal Processing I, Image Processing*

Technical Skills

** To be completed by Nov '22*

Languages	C/C++, Python, Fortran, MATLAB, LaTeX
Packages/Libraries	NumPy, Matplotlib, SciPy, SymPy, Pandas, Numba, OpenMP, CUDA
Other Software	Geant4, Git, Proteus, Photoshop, LTspice, EAGLE, Arduino

Extracurricular Activities and Interests

- Awarded NASA Astronomy Picture of the Day for processing raw data from the Hubble Space Telescope *('20)*
- Captured images of several **deep sky objects** using basic equipment as an **amateur astrophotographer**
- Awarded a **cash prize** and an **internship offer** as **sole winner** out of **20+** teams in the **Astronomy General Championship** conducted by Nayam Innovations and Institute Technical Council, IITB *('22)*
- Attended the 3-day **Vijyoshi National Science Camp** conducted at **IISc Bangalore** for facilitating interactions between KVPY Fellows and world-renowned researchers from various fields of science *('19)*